INVARIANCE IN COMPUTER VISION

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Submitted
in fulfilment for the requirements of the degree of
DOCTOR OF PHILOSOPHY

DEPARTMENT OF MATHEMATICS
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
INDIA

JULY 1998

CERTIFICATE

This is to certify that the thesis entitled INVARIANCE IN COMPUTER VISION being submitted by Mr. Naveen Kumar in the Department of Mathematics, Indian Institute of Technology, Delhi for the award of degree of Doctor of philosophy is a record of the original bonafide research work carried out by him under our guidance and supervision.

The thesis or any part thereof has not been submitted to any other University/ Institution for the award of any degree or diploma.

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ACKNOWLEDGEMENT

I am highly indebted to Dr. S.K. Gupta of Department of Computer Science & Engineering and Professor J.B. Srivastava of Department of Mathematics for their constant guidance at each stage of my work beginning with problem definition, through designing solution strategy, verification of results, and finally writing thesis. I owe them a lot for their patient support and affection through out the period of the research work.

I am thankful to Professor S.R.K. Iyengar, Head of the Department, Professor M.C. Puri, Chairman, Departmental Research Committee, and other members of the Department of Mathematics for their overall support and encouragement. I am thankful to my friends Ashok, Shailendra, and Ketan, for their support in computations, B.G.Prasad and K.C.Ravishankar for their timely help in correcting drafts of the thesis, and Vasudha and Ragini for their participation in several discussions.

I greatly acknowledge the support I received from the DST project 'Interpretation and Applications of Invariants in Computer Vision'.

I owe a lot to my family members for their valuable emotional support, particularly to my wife Meenakshi, who has been postponing her own research plans to see me with a Ph.D. Last but not the least I owe to my son Arpit to whom I have not been able to devote any time, Sunday after Sunday, for several months now.

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ABSTRACT

Initial approaches to computer vision were based on photometric properties. The fundamental difficulty with this approach is that the image of an object depends on the viewpoint and orientation. As the camera parameters are usually unknown, it becomes necessary to have descriptions of objects which remain invariant under a class of viewing transformations.

An invariant is a property which does not change for a suitable class of transformations. For example, distance is an invariant property of the Euclidean group of transformations as the distance between two points remains unchanged for any Euclidean transformation (rotation and translation), parallelism is an invariant property of the affine transformation group, while collinearity is an invariant property of the projective transformation group. The hierarchy of transformation groups – projective, affine, and Euclidean induces a natural hierarchy on invariants. In this thesis we are primarily concerned with the study of invariants for object recognition.

A scheme for recognition of smooth two dimensional objects based on normalized representation is given. The curve is segmented on points of bitangency. The scheme is based on Rothwell's approach.

We study projective reconstruction from multiple views from uncalibrated perspective pin-hole model cameras. The main aim is to develop some new algebraic and geometric methods for projective reconstruction from the images. G–reconstruction, a new framework for reconstruction is introduced. The relationship between group action and algebraic invariants is studied in detail.

Invariants form the basis of the non-accidental properties in perceptual organization. However, such invariants are very different from algebraic and differential invariants and are difficult to quantify. We study the role of proximity in perceptual organization and give a new algorithm for its use in object recognition.

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